The Diagnostic Laboratory in the Civil Defense for Biological Warfare

JOHN J. PHAIR, M.D., Dr.P.H., F.A.P.H.A.

Professional—like public—apathy about civil defense is compounded of all-too-human reluctance to face unpleasant possibilities and the assumption that nothing practical is being done anyway. This paper addresses itself to the second factor and will help to disabuse all health workers of that common misapprehension.

✢ Biological warfare (BW) is the intentional use of living organisms or their toxic products to cause death, disability, or damage in man, animals, or plants. The primary target is man, either by causing sickness or death, or through limitation of his food supplies or other agricultural crops. Man must wage a continuous fight to maintain and defend himself, his animals, and his crops in competition with insects and microorganisms. The aim of BW is to overcome these efforts by deliberately distributing large numbers of organisms or pests of native or foreign origin or their toxic products, taking advantage of the ability to utilize more effective methods of dissemination and unusual portals of entry.

Among the human bacterial diseases suggested are bacillary dysentery, cholera, brucellosis, tularemia, anthrax, plague, glanders, typhoid, the leptospiroses, treponematoses, and salmonelloses. In the virus field are found psittacosis, the several encephalitides, influenza, Rift Valley fever, infectious hepatitis, dengue, and smallpox. Certain rickettsial infections, epidemic, endemic, and scrub typhus, Rocky Mountain spotted fever, and Q fever have been named. Fungus diseases, such as coccidioidomycosis, histoplasmosis, nocardiosis, and blastomycosis have been included. Protozoal infections, including malaria, amebic dysentery, and toxoplasmosis, have been mentioned. Finally, the toxins formed by Clostridium botulinum, Corynebacterium diphtheriae and various staphylococci, are usually listed.

Turning to domestic animals, there are many target populations, each with its individual entourage of parasites. Diseases not commonly found in this country are most often described as possible BW hazards. They include foot-and-mouth disease, rinderpest, Rift Valley fever, Teschen disease of swine, hog cholera variants, fowl plague, and the highly fatal strains of Newcastle disease. The native infections, such as anthrax, brucellosis, tuberculosis, hog cholera, vesicular exanthema, vesicular stomatitis, pullorum disease, fowl paralysis and the upper respiratory infections of chickens, pigs, and cattle cannot be overlooked. Some can be as damaging as any exotic organism if permitted to run unchecked.

In the plant field are found even a greater number of possible target populations and biological agents. It seems likely that various viruses, fungi, certain bacteria, nematodes, and many insect pests would be considered.

There are many methods easily adaptable for intentional dissemination. Bombs or spray generators can produce

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Dr. Phair is professor of preventive medicine, College of Medicine, University of Cincinnati, Cincinnati, Ohio; and Consultant on Biological Warfare, Federal Civil Defense Administration. This paper was presented before the Laboratory Section of the American Public Health Association at the Eighty-first Annual Meeting in New York, N. Y., November 10, 1953.

aerosol clouds of the biological material for limited targets or to blanket wide areas. Aircraft, balloons, submarines, and surface vessels can launch similar attacks using many devices. Saboteurs can readily contaminate air, water, and food supplies.

Animal diseases can be introduced and spread secretly through feeds, biologics, raw garbage, and even by infested wearing apparel. The utilization of wild animals cannot be overlooked. There are three avenues for use against plants and crops: (1) the destruction of plants during the growing season by chemical attack; (2) a mass inoculation with pathogenic spores; (3) the introduction—probably by covert means—of exotic pathogens or pests which would become serious disease or insect problems later.

Extreme statements have been made concerning the feasibility of this weapon and available defenses. Because history records the devastating action of epidemics and pandemics, it has been predicted that in the event of a successful BW attack entire populations would be disabled followed by a high mortality. Conversely, it has been asserted that the hazard would be small because man, his animals, and his crops have survived centuries of natural exposure to infectious pathogens. All these estimations are speculative because the evidence required for a critical appraisal will not be available until BW has been attempted.

The lists of possible agents and suitable methods of dissemination, it is clear, are long and varied. It is equally obvious that any number of parasites, either alone or in combinations, might be employed under widely differing conditions. This freedom of selection hinders the appraisal of the hazard and emphasizes the broad approach, both diagnostic and therapeutic, required for BW defense planning. It would be foolish to prepare for only a single agent or to assume that a determined aggressor would not take advantage of the opportunity to pick and choose his weapon.

In light of present knowledge, a reasonable assessment of the hazard would place it somewhere between the two extremes described earlier. Therefore, the Federal Civil Defense Administration plans assume that a determined enemy can and may attack man, animals, or plants effectively by deliberately spreading pathogenic agents, covertly or overtly, alone or in combination with other weapons. On the other hand, the stand is taken that the accumulated understanding of the epidemiology and control methods for human, animal, and plant parasites in the fields of preventive medicine, public health, and agriculture is sufficient to permit development of an acceptable civilian defense.

Defense Plan

Prior to an attack, emphasis is being placed on maintaining and increasing the resistance of target populations by improving those organizations and measures devised to protect the health and well-being of this country. Even though deficiencies exist, it should be recognized, but not complacently, that the United States is far better equipped in this regard than many other countries. There is no need to change federal, state, and local programs, but steps should be taken to bring about continuing, over-all improvement in facilities, equipment, and procedures, including the provision of trained personnel.

During an attack it is essential to know quickly when and where a BW agent was used and what it was. These will be difficult questions to answer in time to initiate countermeasures. Accurate, rapid means for detecting and quickly identifying foreign material in air, water, or foodstuffs are among the major needs in the BW defense field. Those available at present cannot be relied upon, since most require hours, days, or even weeks to complete. Entirely new technics, apparatus, and materials are required. Further complications may be caused by an enemy's ability to attack covertly or to employ BW in combination with other weapons. Constant monitoring of environmental elements while desirable is only feasible for relatively small, well controlled areas.

Intensive programs to develop satisfactory technics for a limited operation of semiautomatic mechanisms are under way. At the same time, it must be recognized that there is no thought that such measures will be available for immediate use in the civil defense program. Even if the explorations are outstandingly successful, field application will have to be carefully weighed in order not to overburden existing facilities.

Until means are available for quickly detecting biological agents, a defense during attack is difficult. Protective devices, collective and individual, used arbitrarily during overt actions may offer some help for man. Little can be done for animals or plants. After an overt attack, opportunities may be found to examine unexploded munitions or "duds." Then the atmosphere or surfaces could also be sampled. Health departments, animal, and plant disease control agencies, physicians, veterinarians, and individual citizens then must combat the infectious agents or pests introduced. Possible measures include identification of the agent, prompt reporting of cases, protection of susceptibles, treatment or eradication (animal and plants) of infected hosts, and disinfection of infected areas. The relative importance of each is quite different for human, animal, or plant populations.

Until satisfactory methods for environmental sampling have been perfected, disease remains the most reliable indicator of BW agents. The occurrence of an unusual case or of an epidemic in all probability will be the first signal that a BW attack has been made. As a consequence, prompt diagnosis, reporting, proper therapy, followed by epidemiological investigations, become the keystones of the present BW defense plans.

No new pattern is demanded. For man, physicians will rely upon the local health department for diagnostic assistance. The state health department should support local efforts and should call upon the regional director of the Public Health Service. He, in turn, should seek aid from the section coordinator of the Sectional Research Program, the Communicable Disease and Environmental Health Centers of the Public Health Service, the Federal Civil Defense Administration—regional and national—and the Department of Defense.

Each area may vary somewhat in the formulation of operating procedures. The outline suggested previously follows the usual peacetime pattern for most situations. It should be recognized, however, that the channel as described is not necessarily the only one that can be used. If satisfactory liaison is established between the interested groups, many modifications are possible.

For animals, the BW defense program involves cooperation of the Bureau of Animal Industry of the Department of Agriculture, the State Livestock Sanitary Board, and the Public Health Service of the Department of Health, Education and Welfare. Channels for diagnosis, reporting, and control are under their supervision. In the plant field, knowledge of the biology and ecology of exotic diseases is being extended by the Department of Agriculture.

Role of the Diagnostic Laboratory

Two major areas in the civil defense program for BW become the responsibility of the diagnostic laboratories, federal, state, and local. The first is the problem of detection and identification of deliberately disseminated biological agents in the environment. The second is the part played in the diagnosis, reporting, therapy, and epidemiological investigations of disease.

Since practical methods for collecting and identifying BW materials in air, water, food, and on surfaces are still being sought, FCDA at this time is not recommending routine testing. However, experimental trials or research are welcome and should be supported. Two avenues are open—physical detection, using various impinging or filtering procedures is one; and the other is biological detection, utilizing known bacteriological or immunological methods. (There is no reason to describe either in detail in this paper.) The experience gained through such efforts would be valuable if a satisfactory detection system should be developed and approved. Furthermore, there is the need to accumulate background data regarding the kind and amount of biological materials commonly occurring in the environment.

The need to improve and speed identification procedures also warrants attention. Even if rapid detection methods were found in the future, the problem of identifying the agent still remains. Proper countermeasures cannot be considered or instituted if the agent is unknown.

Until such procedures are available and the technical problems of immunization and prophylaxis are solved, defense efforts will be restricted to minimizing rather than preventing disease. Such goals include shortening the period of incapacitation, reducing the number of deaths, and preventing the occurrence of secondary or contact cases.

In the event of successful BW attack, casualties will be sent to the community clinics and hospitals, and the first diagnostic procedures will be carried out locally. Many problems will be encountered because of the variety and complexity of the clinical and laboratory procedures required to establish diagnoses following exposure to BW. In some aspects, these will be more difficult to solve than those met with in environmental sampling. Single BW agents or combinations may be involved or unusual portals used. As a result, it may be expected that the syndromes will not follow classical patterns.

The laboratories of communities, hospitals, and health departments must be prepared to meet this demand. The state and local civil defense and health authorities should inventory and expand the resources under their jurisdiction. The regional FCDA offices will assist in so far as possible. This effort should include: (1) a survey of the facilities which may be required, including equipment and reagents which are now available; (2) an exploration of the potential capabilities of private laboratories operating in the same jurisdiction, be it state or local; (3) planning of actual procedures and steps to be taken to meet emergency needs, whether they should arise from natural disasters, wartime emergencies, or biological warfare; (4) designation of personnel to be prepared to handle specific diagnostic laboratory procedures and routines; and (5) strengthening the channels of communication for immediate reporting and interchange of information at the working level.

These are only a few examples of the steps which can be taken at the present time. They do not require specific authorization or assistance. Most laboratory directors and supervisors have a sufficient awareness of the problems which will be encountered to assume the responsibilities for planning specific and detailed operating procedures. It is recognized that efforts may be subject to possible modifications as additional information becomes available.

One can only guess at the kind and extent of facilities, clinics, and laboratories required to provide the required detection and diagnostic services. State laboratories will continue to serve for consultation or assist if local facilities are overtaxed. This customary relationship should serve equally well for meeting the hazard of BW. Additional consulting laboratories may become necessary. The number of specialized laboratories in which skills exist for identifying exotic or unusual agents need not be large, but all parts of the country should have ready access to these facilities. An important consideration which enters into this assumption is that the amount of unusual work need not be large As is found during the peacetime investigation of epidemics, only the early cases need detailed study. Likewise, only a relatively small number of air, water, or food samples will require elaborate analyses.

The Sectional Research Program of the National Microbiological Institute has already mobilized certain research and diagnostic facilities, particularly in the virus field. This can serve as the initial nucleus of an integrated standby support. At present, although hampered by a limited budget, additional participation by laboratories is being sought, particularly from state health departments. Tests are being standardized, antigens and antisera are in process of evaluation, and facilities are being expanded.

The FCDA is supporting these latter activities. This is one of the goals of the Contributions Program of this agency for the coming year. It has been proposed to: (1) assist states and their political subdivisions in acquiring adequate laboratory supplies for conducting training of technicians in the problems of biological warfare defense; (2) aid states in joining in the development of technical defense measures for agents directed at man and animals; and (3) assist the states in the development of programs to train personnel in the proper methods of detection, isolation, and identification of BW agents and for the diagnosis of disease to prepare them for possible service as technicians in biological warfare defense.

The first step was to secure a method of furnishing equipment for such efforts. The FCDA in its Contributions Program now will consider approvable the following examples of diagnostic reagents and supplies in order that states can begin certain training programs: (1) antigens and antisera of typhoid, paratyphoids, typhus (murine), brucellosis, and various strains of Shigella and Salmonella; and (2) common small laboratory equipment items, such as pipettes, cylinders, flasks, spot plates, racks, cotton plugs, and mailing cases.

It would be desirable also to have a liaison worker devoting full time to BW problems at the section level. With such help, all laboratories in the area might serve as focal points for training in the diagnosis of unusual infections, receiving information regarding possible BW attacks, and assisting in the investigation of suspicious disease outbreaks.

The success of the entire defense depends upon the availability of competent, trained professional and technical personnel. Since their defense activities with only a few exceptions are essentially those of peacetime medicine and public health, no unusual background is required. However, it would be advisable to arrange for refresher courses at the state and local level in some of the standard health procedures, such as the diagnosis and treatment of the communicable diseases. Diagnostic laboratories can play a major role in this activity.

The program need not be elaborate or complex. To meet the problems of BW only a small amount of extra material must be added to courses already provided for peacetime duties. The principal objective will be to alert the health agencies, the physicians, and the civil defense authorities to the problems presented by the use of a biological weapon directed at man.

All must insure a reasonable understanding of BW by the public. Hazards and defense mechanisms must be accurately described and evaluated. Since the defense of the individual is essentially a personal responsibility, the end goal is adequate orientation of the individual citizen.

The proposed training can be supplemented by: (1) brief programs for alerting professional personnel given at meetings—state, regional, or national—of groups, such as the American Public Health Association, American Medical Association, Society of American Bacteriologists, Association of State and Territorial Health Officers, and many similar organizations; (2) refresher courses in the diagnosis and control of communicable disease to be given by state health departments, the Academy of General Practice, and similar groups for local practitioners and allied professional personnel; and (3) technical training under the auspices of state and local health agencies in emergency environmental sanitation and food inspection.

Only token support has been obtained for these efforts thus far, in spite of the great interest in this subject. The Public Health Service through its Communicable Disease and Environmental Health Centers offers courses for health personnel covering certain aspects. The programs which might be of some value in BW have been opened to a limited number of civil defense personnel. In a cooperative effort, additional emphasis has been placed on aspects of BW by our professional schools. Medical, veterinary, and nursing students will be given a greater amount of instruction in the diagnosis of infectious diseases and emergency sanitation. However, much remains to be done.

Summary

For the general population, BW defense is centered upon the rapid recognition, reporting, and treatment of cases. Until detection procedures are available, efforts can be directed only at minimizing rather than preventing casualties. Specific countermeasures are limited in number and applicability. The stand is taken that no entirely new problems will be created and the present health facilities, especially in the laboratory field, will form the principal bulwark. There is no need to change the programs, but it is necessary to bring about continuing, over-all improvement in personnel, facilities, equipment, and procedures to strengthen this defense. It should be recognized, but not complacently, that even though deficiencies exist, the United States is better equipped to meet this threat than many other countries.

This approach depends upon the availability and distribution of professional personnel, particularly in the diagnostic laboratory. Since their duties are essentially unchanged, no unusual training is envisioned. Refresher courses may be needed in the diagnosis and treatment of communicable diseases. Programs must be designed to bring understanding to all levels of the population. Since defense finally is always a personal affair, the final goal is the orientation of the individual citizen to the danger and his responsibilities.